

L3 ANSWER 11 OF 19 CAPLUS COPYRIGHT 2003 ACS

AN 1992:662441 CAPLUS

DN 117:262441

TI Metallic impurities segregation at the interface between silicon wafer and liquid during wet cleaning

AU Ohmi, T.; Imaoka, T.; Sugiyama, I.; Kezuka, T.

CS Fac. Eng., Tohoku Univ., Sendai, 980, Japan

SO Journal of the Electrochemical Society (1992), 139(11), 3317-35

CODEN: JESOAN; ISSN: 0013-4651

DT Journal

LA English

CC 76-3 (Electric Phenomena)

Section cross-reference(s): 66

AB An extensive lecture with 21 refs. on Si wafer surface cleaning and metallic impurities adsorption and segregation at its surfaces, considering relative electronegativities. The ultraclean wafer surface must be perfectly free from particles, org. materials, metallic impurities, native oxides, surface microroughness, and adsorbed mol. impurities. Metallic contamination, the major type of contaminants to be overcome, has a fatal effect on device characteristics and must be suppressed to at least below  $10^{10}$  atom/cm<sup>2</sup>. The current dry processes, such as reactive ion etching or ion implantation, cause metallic contamination as high as  $10^{12}$ - $10^{13}$  atom/cm<sup>2</sup>. The wet process becomes increasingly important to remove these metallic impurities introduced during dry processing. Employing a new evaluation method, the metallic impurity segregation at the interface between the Si wafer and the liq. in the wet cleaning process was studied. It has been found that metals, such as Cu having higher electronegativity than Si, are directly adsorbed on the Si surface by taking an electron from the Si. On the other hand, metals, such as Fe and K having lower electronegativity than Si, are not adsorbed on the Si surface. In the normal wet cleaning process when a native oxide is formed on the Si surface, metals such as Fe and K that are oxidized more easily than Si, are preferentially included into the native oxide. When the metals are in **ultrapure** water or chems. with a concn. of 1 ppb, they are included into the Si surface, and native oxide with evaluation was  $10^{12}$ - $10^{13}$  atom/cm<sup>2</sup>. Therefore, to decrease the metallic contamination level on the Si surface to levels less than 1 .times.  $10^{10}$  atom/cm<sup>2</sup>, the metallic impurities must be suppressed to at least below the 1 ppt level in **ultrapure water** and high-purity HF, which are employed in the final step of the cleaning process. To prevent the metallic contamination on the wafer surface, it was found that it is important to maintain an inert atm., such as N<sub>2</sub> or Ar, to suppress native oxide growth and to reduce metallic impurities in the **ultrapure water** rinse. Moreover, it has been found that the dild. HF-H<sub>2</sub>O<sub>2</sub> cleaning is effective in removing metals such as Cu, having high electronegativity, from the Si surface at room temp. and that it does not induce surface microroughness. This means the dild. HF cleaning, which has been employed in the final step of the conventional wet cleaning process to remove the native oxide, needs to be replaced with the dild. HF-H<sub>2</sub>O<sub>2</sub> infin. cleaning. It was also found that surfactants added to improve the wettability of chems. on the Si surface were also able to prevent metallic impurity pptn. on the wafer surface.

ST silicon surface metal electronegativity segregation; metal impurity adsorption silicon electronegativity; cleaning wet silicon surface metallic impurity

IT Adsorption

(of metallic impurities, on silicon wafer surface and interfaces, electronegativity in)

IT Adhesion

(of metallic impurities, on silicon wafer surface, electronegativity

in)

IT Electronegativity  
 (of metallic impurities, segregation and adsorption at silicon surface  
 in relation to)

IT Cleaning  
 (of surface from metallic impurity, electronegativity effect on)

IT 7664-39-3, Hydrofluoric acid, uses 7722-84-1, Hydrogen peroxide, uses  
 RL: USES (Uses)  
 (in silicon surface cleaning, from metallic impurities)

IT 7440-21-3, Silicon, properties  
 RL: PRP (Properties)  
 (metallic impurity at surface of, electronegativity effect on)

IT 7664-39-3, Hydrofluoric acid, uses 7664-93-9, Sulfuric acid, uses  
 RL: USES (Uses)  
 (silicon surface cleaning by, from metallic impurities ,  
 electronegativity in)

IT 7439-89-6, Iron, uses 7440-02-0, Nickel, uses 7440-50-8,  
**Copper**, uses 7440-66-6, Zinc, uses  
 RL: USES (Uses)  
 (silicon surface cleaning from impurities of, wet, relative  
 electronegativity in)

(FILE 'HOME' ENTERED AT 10:20:21 ON 10 JUN 2003)

FILE 'CAPLUS, JAPIO' ENTERED AT 10:20:49 ON 10 JUN 2003

L1	3283 S (ULTRAPURE OR ULTRA (W) PURE) (2W) WATER
L2	186 S L1 AND (COPPER OR CU)
L3	19 S L2 AND PPB
L4	56 S L2 AND CONCENTRATION
L5	49 S L4 NOT L3
L6	0 S L5 AND BILLION
L7	24 S UPW AND (COPPER OR CU)
L8	1 S L7 AND PPB